



COMPOSITIONAL CHARACTERIZATION OF THE CRUDE OIL FROM THE RECÔNCAVO BAIANO USING SAR METHODOLOGY

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Abstract

In the oil industry the SAR method is one of the most used for the characterization of oils, since the composition analysis of these oils provides important information that impacts oil exploration, production and transportation. Therefore, this study aimed to perform a column chromatography on a sample of crude oil from the *Recôncavo Baiano* and separate it in three distinct fractions based on the polarity of the compounds, wherefore was realized a gas chromatography (whole gas), in order to obtain important information about the main groups of hydrocarbons present in the oil sample. Furthermore, it is possible to predict the interactions of the oil components with chemical agents that can be applied in future work to increase the oil recovery factor. The results show that the highest component percentage was composed by saturated fractions (79%), and from a ternary diagram, proposed by Tissot (1984), it was possible to observe that oil is defined as paraffinic, which is a characteristic of the oils of the *Recôncavo Baiano*.

Keywords

SAR Method; Recôncavo Baiano; Saturated.

Introduction

Oil is one of the most complex mixtures in the world since it has different chemical structures in abundance. Crude oil is composed mainly of aliphatic, aromatic and naphthenic hydrocarbons, in addition to other compounds such as sulfur, oxygen, nitrogen and complex organometallic constituents such as nickel and vanadium [1], [2]. The complexity of crude oil composition and its high importance for the energy sector demand the development of separation techniques in order to characterize the fractions present in oil. One of the main methodologies used to classify different oil types oils is liquid column chromatography (SAR), which consists of separating by polarity difference the three largest fractions, being them: saturated hydrocarbons, aromatic hydrocarbons, but which contains heteroatoms such as, nitrogen, sulfur and oxygen [2], [3].

In the oil industry the SAR method is one of the most used for the characterization of oils, since the composition analysis of these oils provides important information that impacts oil exploration at all stages of the value chain, from exploration to production, transportation and refining [4]. Moreover, it is also possible from the percentage content of each fraction to determine geochemical parameters of maturity/degradation, according to that established between the composition of 636 different types of oils as a function of the percentage of fractionated compounds with boiling point above 210 °C [5]. In addition, it is also possible to obtain a prospect about the interactions

between a crude oil and chemical agents to increase the oil recovery factor.

Within this context, the aim of this work is to characterize the petroleum fractions from the *Recôncavo Baiano* using liquid chromatography technique (SAR method) to identify the geochemical properties of the pioneer basin in oil exploration in Brazil. The main characteristics of the oil can be used to choose the appropriate surfactant or other chemical agents to use a chemical EOR.

Methodology

The analysis of liquid column chromatography was performed based on the standard ASTM D 4124-096 [6], which it consisted in the preparation of the stationary phase through the packaging of the chromatography column with silica in hexane; the insertion of about 0.1 g of activated sodium sulfate and, finally, approximately 20 mg of the oil sample. In the mobile phase, organic solvents were used to absorb and transport the fraction of oil constituents in the following sequence: the saturated fraction was eluted with 30 mL of n-Hexane; the aromatic fraction was eluted with a mixture of Hexane/Dichloromethane (1:4, v/v, 40 mL) and, at last, the NSO fraction was eluted with Dichloromethane/Methanol (4:1, v/v, 40 mL). The solvent present in each step in the collected fractions was evaporated to obtain the mass percentage of the recorded fractions. It is

noteworthy that the analyses were performed in triplicate to ensure data reliability.

The analysis of gas chromatography (whole oil), that followed the ASTM D2887-02 [7], was performed on a VARIAN CP-3800 gas chromatograph, with flame ionization detector and flow of carrier gas (helium).

Besides the aforementioned characterization, we also performed physical-chemical oil properties evaluation. The density and the °API were analyzed in a portable digital densimeter from standard ASTM D 5002-92 [8]; and viscosity was investigated in a Brookfield rheometer that followed the ASTM D 2196-10 [9].

Results and Discussion

Oil from the Onshore field in the *Recôncavo Baiano* presents the physical-chemical properties reported in Table 1. The viscosity was determined from 30 °C to 60 °C, since the oil pour point of the *Recôncavo* region is 33 °C [10]. The analysis of density and °API were performed from 20 °C to 60 °C, the last being the average temperature of the oil reservoirs.

Table 1. Physical-Chemical Properties of oil from *Recôncavo Baiano*.

Properties	20 °C	40 °C	50 °C	60 °C
Density(g/cm ³)	0.863	0.838	-	0.822
°API	32.17	34,28	-	34,38
Viscosity (cP)	-	22.80	13.30	9.18

The geochemical characterization of the oils, based on the classification of SAR components through liquid chromatography, allowed for to identify their composition, which contains: i) saturated hydrocarbons (normal, branched and alkane cycle), ii) aromatic hydrocarbons (including aromatics with a ring, aromatic cycle and usually sulphurated cyclic compounds) and iii) resins and asphaltenes (high molecular weight polycyclic fraction containing N, O and S atoms [5], [11].

The percentages for saturated hydrocarbon fraction were approximately 79.01%; the value for aromatic hydrocarbons was about 12.11%; while NSO compounds (resins + asphaltenes) were 8.88% (Tab. 2).

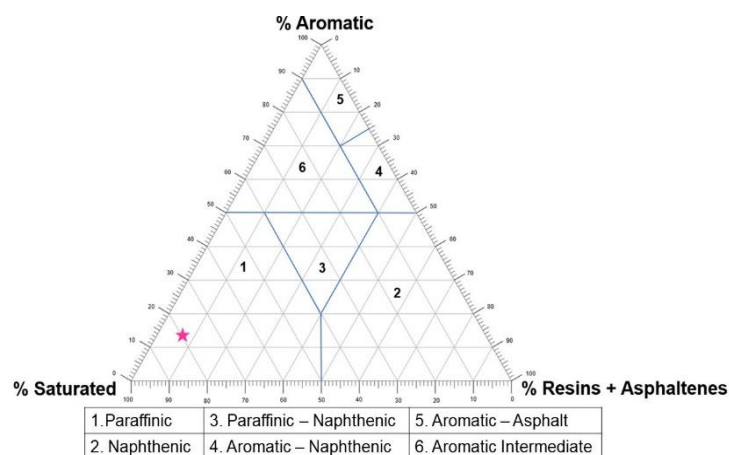
Table 2. Mass percentage of saturated, aromatic and NSO compositions.

Mass Percentage		
Saturate	Aromatic	Resin
79.01	12.11	8.88

According to the Tissot classification (1984), the overall composition of the samples is composed of paraffinic oils, due the predominance of saturated hydrocarbons (> 50%) [5]. Thus, the oil is considered more thermal evolution, property

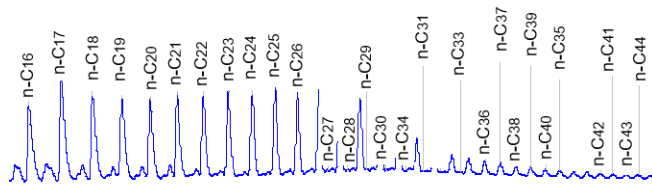
responsible to conversion of sedimentary organic matter to oil and gas, because they are originating from a process that resulted in high paraffinity.[12]. From the results of the SAR analysis, it is possible to measure the level of maturation/biodegradation of the oil, through the ternary diagram, proposed by Tissot (1984), oil characteristics are determined (Figure 1). Wherefore, the oil sample is stated in the region paraffinic, which is accordance with characteristic of the *Recôncavo* oil. In addition, the oil sample presented as little biodegraded, which is a characteristic of paraffinic oils [5].

Figure 1. Ternary Diagram of saturated, aromatic and NSO fractions from *Recôncavo Baiano*.



Oils classified as paraffinic present a medium molecular weight with long hydrocarbon chains [13]. Therefore, both the ternary diagram of Tissot and the classification of the oil as being light (values of °API > 30°) are in agreement with the characteristic of *Recôncavo oils*, which are predominantly formed by a high fraction of paraffinic and do not have a high content of heavy fractions such as resins and asphaltenes [14],[15]. From the analysis of gas chromatography, the fingerprint Fig. (2), from the oil sample of the *Recôncavo* Basin, revealed a significant distribution of low molecular weight n-paraffins, with higher abundances in the peaks (nC₁₇-nC₁₉) and (nC₂₀-nC₂₉). According to Azevedo et al., (2009), paraffins are observed in oils with predominance of low molecular mass compounds (nC₁₀ to nC₄₀) [16]. Therefore, a high percentage of paraffins in the *Recôncavo* oil sample, connected to its high °API and high saturated content, is in accordance with the characteristic with the oils of the *Recôncavo* region.

Figure 2. Total oil chromatogram and fingerprint of oil from Recôncavo Baiano - Brasil.



Conclusions

The determination of the main hydrocarbon fractions presents in the crude oil sample of the *Recôncavo Baiano* region, through the SAR methodology, revealed that saturated fractions predominate in the overall percentage, with about 79%; and the fractions of aromatics and NSO compounds presented little significant values, 12% and 9%, respectively. Moreover, crude oil exhibited a paraffinic characteristic, which is a common aspect in oils of *Recôncavo Baiano*, with high content of saturated and classified as light oils ($^{\circ}\text{API} > 30$). Ultimately, the analysis data will be used to understand the interaction of the hydrocarbons with the surfactants solution to increase the oil recovery.

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Responsibility Notice

The authors are the only responsible for the paper content.

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